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## USGS

The U.S. Geological Survey is a science organization that provides the Nation with reliable, impartial information to describe and understand the Earth. The national USGS home page:  
<http://www.usgs.gov>

### This USGS program:

Internet address for precipitation data at wells DTX2, D25, DTX5 (South Platte River Basin):  
[http://co.water.usgs.gov/rt-cgi/gen\\_tbl\\_pg\\_mt](http://co.water.usgs.gov/rt-cgi/gen_tbl_pg_mt)  
or <http://nwis-colo.cr.usgs.gov/>

Internet address for quarterly reports:  
<http://co.water.usgs.gov/projects>

## Program Overview

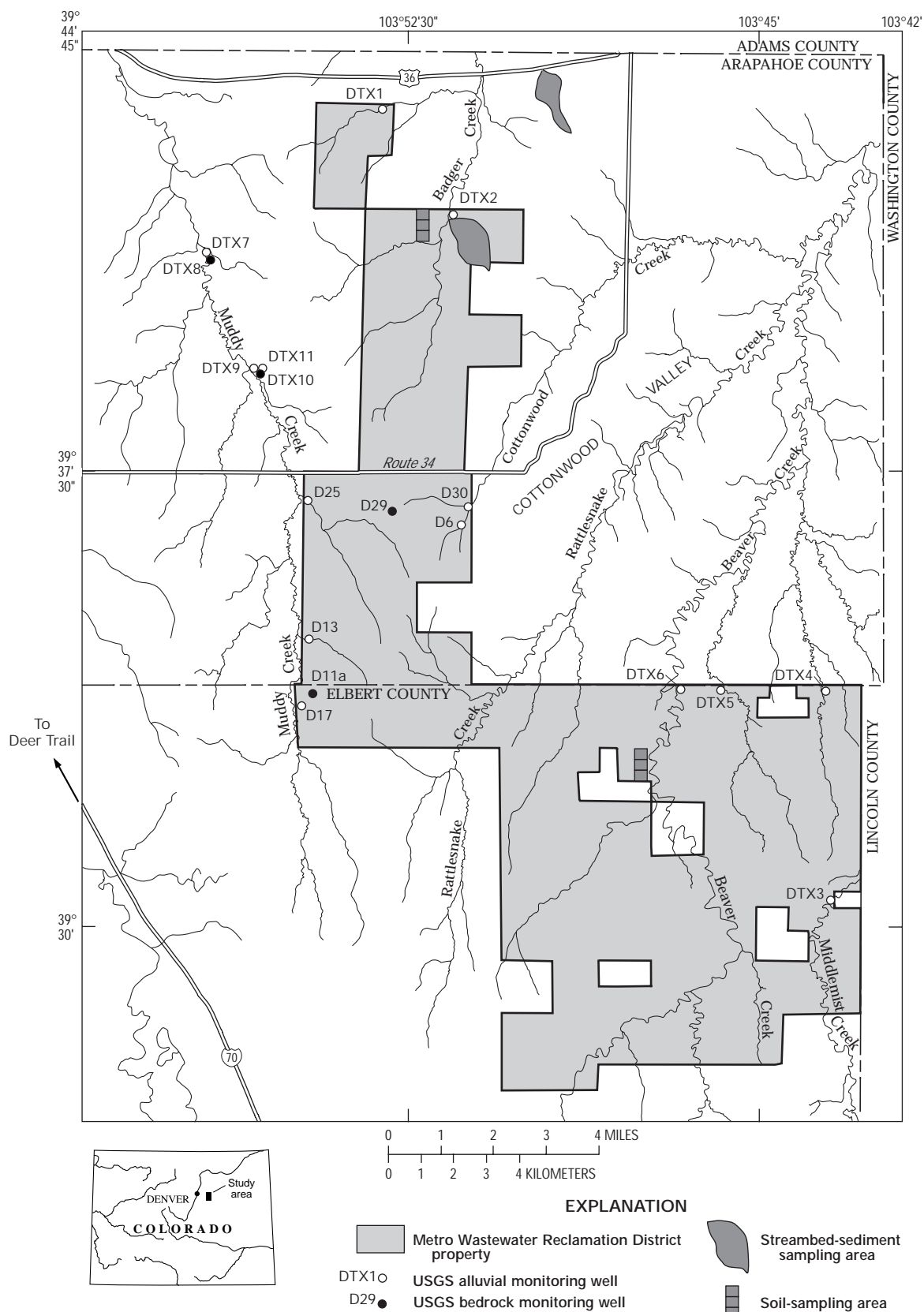
Metro Wastewater Reclamation District (Metro District) applies biosolids to their properties near Deer Trail, Colorado. These biosolids applications could affect the quality of water in alluvial and bedrock aquifers, streambed sediments, soils, and crops. Water quality can be directly affected through:

- Contaminated recharge water, or
- Infiltration of water through contaminated soils or sediments (remobilization).

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**USGS periodically checks the thermistors that measure temperature at each of the continuous-recorder (DCP) sites. Air temperature is checked by comparing the thermistor reading with a reading from a field thermometer. Ground-water temperature is checked by comparing the thermistor reading with a reading from a certified thermometer in water baths of various temperatures. The thermistor readings for the DCP sites can be viewed on the Internet at the address listed to the left.**



## Program Overview

*Continued from page 1*

Water quality can be indirectly affected through:

- Plowing that mobilizes or changes subsurface chemical constituents, or
- Contributions to natural processes such as nitrification.

Contaminated ground water or surface water could contaminate:

- Other aquifers, such as bed-rock water-supply aquifers or alluvial aquifers,
- Other surface-water bodies (ponds or streams), or
- Streambed sediments.

Biosolids must meet metals and radioactivity regulations, or else agronomic loading rates will be incorrect and soils could be overloaded. Soil quality could either be improved by biosolids applications through increased nutrients and organic matter, or degraded through excessive nutrients or metals.

The U.S. Geological Survey (USGS) has designed and begun a new monitoring program to address concerns from a stakeholder group about the biosolids and the quality of the environment in the vicinity of the biosolids-application areas. The new USGS monitoring program near Deer Trail is referred to as the "USGS Expanded Monitoring Program" and began in January 1999.

This monitoring program is distinct from, but builds on, another

USGS program that monitored shallow ground-water quality on the Metro District Central Farm from 1993-1998. The new program (1999-2005) considers environmental-quality issues for shallow and deep ground water, surface water (bed sediments), soils, crops, and the biosolids. The new expanded monitoring program includes all three Metro District properties (North, Central, and South Farms) and related private-property locations. Both programs, however, use USGS and Metro District funds. In addition, the new monitoring program also uses funds from the North Kiowa Bijou Ground Water Management District. Both programs are designed, carried out, and interpreted independently by USGS, and quality-assured USGS data and reports will be released to the public and the Metro District at the same time. By definition and design, all USGS monitoring programs are independent and unbiased.

The objectives of the new Expanded Monitoring Program are to:

- (1) Evaluate the combined effects of biosolids applications, land use, and natural processes on alluvial aquifers, the bedrock aquifer, streambed sediments, soils, and crops by comparing chemical data to

- State or Federal regulatory limits,
- Data from a site where biosolids are not applied (a control site), or

- Earlier data from the same site (trends).

(2) Monitor biosolids for metals and radioactivity, and compare the concentrations with regulatory limits.  
(3) Determine the aquifer hydrology in this area.

The approach is unique for each component of the Expanded Monitoring Program. However, appropriate USGS methods and technologies will be applied to each component.

Quarterly reports such as this one will be distributed to the stakeholders and other concerned people, as well as available to the general public on the Internet (<http://co.water.usgs.gov>). Each quarterly report will summarize progress from the previous quarter and plans for the current quarter; chemical data will be included every other quarter. A USGS report will be prepared annually and made available after each year of the monitoring program: the reports will include data for that year, any interpretations for that year, and statistical analysis for the data to date. A comprehensive USGS report will be prepared and available after five years of monitoring that includes complete statistical analyses and interpretations. In addition, the USGS will meet with the stakeholders once a year to discuss the Expanded Monitoring Program results and to consider possible changes to the Expanded Monitoring Program.

## Questions & Answers

**Q:** Does USGS have monitoring wells on or in the vicinity of the Metro District properties other than the network of wells shown on the map on page 2?

**A:** Yes. USGS has 32 monitoring wells from the previous monitoring program (1993-1999); 30 of these wells are shallow (2 are dry), 2 wells are deep (bedrock wells), and 7 wells (including both bedrock wells) are part of the monitoring network for the USGS Expanded Monitoring Program.

**Q:** Why aren't the other shallow USGS wells sampled anymore?

**A:** USGS could sample the other wells again, although wells near the Metro District property boundaries are the highest priority because these wells best represent the water quality of ground water leaving the property. Only 6 wells from the previous program are located near Metro property boundaries, and 5 of these wells are sampled for the expanded program.

## Alluvial Ground Water

### Approach

Six new monitoring wells were installed near the Metro District property boundaries in the major alluvial aquifers. These six wells plus five existing USGS monitoring wells will be sampled approximately quarterly for full inorganic chemistry and annually for radioactivity. Data will be reviewed and statistically tested for exceedance of regulations and trends.

### Progress Last Quarter (July--September 2000)

Ground-water levels were measured July 6, August 3, and September 1, 2000. Ground water was sampled for chemistry July 6-13, 2000. Ground-water data were compiled, reviewed, and released in the previous Quarterly Report in September 2000. Most of the reviews of the annual report were completed. USGS presented results from 1999 and the draft 1999 annual report at the second annual stakeholder meeting in September.

### Plans for the Current Quarter (October--December 2000)

Ground-water levels will be measured the first week of each month. Ground water will be sampled in early October, weather permitting. Data will be compiled and reviewed. The 1999 annual report will be completed.

## Bedrock Ground Water

### Approach

A structure map of the base of the bedrock aquifer was compiled and used to determine locations for two sets of new, clustered wells

(one or two alluvial wells and one nearby dual-completion bedrock well comprise each cluster). The well clusters were installed where both the Muddy Creek alluvial aquifer and the Laramie-Fox Hills aquifer are present (along the margin of the bedrock aquifer) near the Metro District properties. One site continuously records water levels and precipitation at the well cluster and has two alluvial wells screened at different lithologies. Water-level data from each well cluster will be used to determine aquifer hydrology and interaction at those two locations. The two bedrock wells (DTX8, DTX10), along with an existing USGS bedrock well (D29), will be sampled approximately quarterly for full inorganic chemistry and annually for radioactivity. Data will be reviewed and statistically tested for exceedance of regulations and for trends.

### Progress Last Quarter (July--September 2000)

Ground-water levels were measured July 6, August 3, and September 1, 2000. Ground water was sampled for chemistry July 6-13, 2000. The measuring-point elevation of the newest monitoring well (DTX11) was surveyed in August. Ground-water data were compiled, reviewed, and released in the previous Quarterly Report in September 2000. Most of the reviews of the annual report were completed. USGS presented results from 1999 including the draft structure map and the draft 1999 annual report at the second annual stakeholder meeting in September.

### Plans for the Current Quarter (October--December 2000)

Ground-water levels will be measured the first week of each

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***USGS carefully measures the “stickup”--how much the well sticks up above land surface. All well and ground-water measurements are made from the top of the well (white PVC) casing instead of land surface because the casing elevation usually does not change, whereas land-surface elevation can change from wind and water deposition or scour. Measurements of well depth and water level can be converted to below land surface by subtracting the stickup from the measurement.***



## **Bedrock Ground Water**

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month. Ground water will be sampled in early October, weather permitting. Data will be compiled and reviewed. The 1999 annual report will be completed.

## **Surface-Water Sediments**

### **Approach**

Surface-water contamination is a concern for the stakeholders, but streams flow off the Metro District properties only during runoff when surface-water sampling is impractic-



***Streambed-sediment samples collected in July were mixed, sieved, and bottled in preparation for laboratory analysis.***

cal. Therefore, possible surface-water contamination from metals will be evaluated by sampling streambed sediments soon after storms. Two small drainage basins were selected for similar characteristics but different land use—one drainage in a biosolids-application field and another drainage in a farmed field



***Streambed-sediment samples were collected July 17, 2000, after rain caused runoff from the biosolids-applied field (above) and the control field. Samples were collected from the fine-grained deposits after runoff.***



***Seed heads from millet plants cut during harvest were sampled by USGS September 27, 2000, at the soil plot in Arapahoe County. These plants and wheat-plant samples from the soil plots in both counties will be chemically analyzed as part of the USGS Crops monitoring component.***

(not on the Metro District properties) that does not receive biosolids. Weather permitting, downstream locations in each of the two drainage basins will be sampled after the same storms as many as four times per year for inorganic constituents (including metals, total nitrogen,

and total phosphorous) and organic carbon, and one time per year for radioactive constituents. Data will be reviewed and statistically tested to determine if concentrations are significantly different between the two drainage basins.

*Continued on page 6*

## **Surface-Water Sediments**

*Continued from page 5*

### **Progress Last Quarter (July--September 2000)**

The site was carefully monitored for runoff-producing precipitation, but precipitation usually was insufficient to produce runoff needed for sampling. USGS monitoring indicated that the only rain that produced runoff in both basins was July 16, 2000, which enabled paired streambed-sediment samples to be collected on July 17, 2000. The July 17 samples were mixed, sieved, and bottled, then submitted to the laboratory for analysis. Data were compiled, reviewed, and released in the previous Quarterly Report in September 2000. Most of the reviews of the 1999 annual report were completed. USGS pre-

sented results from 1999 and the draft 1999 annual report at the second annual stakeholder meeting in September.

### **Plans for Current Quarter (October--December 2000)**

USGS will continue to monitor the site for runoff-producing precipitation. Sampling may take place, depending on the weather. Data will be compiled and reviewed. The 1999 annual report will be completed.

## **Biosolids**

### **Approach**

Biosolids samples will be taken by Metro District staff as a 24-hour composite from the Metro District plant and analyzed by USGS. Biosolids will be sampled and analyzed once each quarter during

most of the program, and once each month for six months when the Lowry Landfill Superfund Site water transfer begins. Data will be reviewed and compared to Federal regulatory limits.

### **Progress Last Quarter (July--September 2000)**

In late July, water transfer from the Lowry Landfill Superfund site began, so monthly biosolids sampling began in August. Metro District personnel collected samples on August 15 and September 25. Each sample was a 24-hour composite from the conveyor belt at the Metro facility. The material was placed in two acid-washed, one-gallon plastic bottles and transported to the USGS in Lakewood. There, the sample was air-dried then ground to less than 150 micrometers.

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***The second annual stakeholder meeting was held September 21, 2000, at the school in Agate, Colorado. USGS presented a compilation of the 1999 results of the Expanded Monitoring Program near Deer Trail, Colorado.***

## Biosolids

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Chemical analyses were completed on the second quarterly (2000) biosolids sample. Biosolids data were compiled, reviewed, and released in the previous Quarterly Report in September 2000. Most of the reviews of the 1999 annual report were completed. USGS presented results from 1999 and the draft 1999 annual report at the second annual stakeholder meeting in September.

### Plans for Current Quarter (October--December 2000)

Biosolids will be sampled each month during this quarter and submitted to the USGS labs for analysis. Data will be compiled and reviewed. The annual report will be completed.



***USGS quality assures measurements of ground-water levels by verifying each measurement with a repeat measurement and (at least annually) checking the measuring tapes against each other and against a tape of known accuracy.***

## Soils

### Approach

One site was selected for characterizing and monitoring the chemical composition of soil on the Metro District property in Arapahoe County, and one site was selected on the Metro District property in Elbert County. Each site consists of three 20-acre (933 feet by 933 feet) fields separated by 100-foot buffer zones. The center 20-acre field at each site has biosolids applied after the initial soil sampling. The other two 20-acre fields at each site will not have biosolids applied and will be used as "control" fields to monitor the natural variability of soil composition for the duration of the study. All three 20-acre fields at each site will be farmed in the normal fashion and have crops planted and harvested. Soils from each of the six fields were sampled before biosolids were applied to the two center fields and will be sampled again after each harvest. Samples will be analyzed for arsenic, cadmium, copper, lead, mercury, molybdenum, nickel, selenium, zinc, plutonium, and gross alpha and beta activity. Data will be examined after 5 years to determine if concentration has changed with time.

### Progress Last Quarter (July--September 2000)

Additional sampling and analysis of soils will not take place until after the current crops are harvested. Most of the reviews of the 1999 annual report were completed. USGS presented results from 1999 and the draft 1999 annual report at the second annual stakeholder meeting in September.

### Plans for Current Quarter (October--December 2000)

Weather permitting, the soil sites will be sampled. This will represent the first sampling since biosolids were applied to the application field several months ago prior to planting.

## Crops

### Approach

Crops from each of the six 20-acre soil-monitoring fields will be chemically analyzed after harvest. Analyses will include arsenic, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, selenium, and zinc.

### Progress Last Quarter (July--September 2000)

On July 6, 2000, mature wheat was sampled from the site in each county. On September 27, 2000, millet was sampled from the site in Arapahoe County.

### Plans for Current Quarter (October--December 2000)

The wheat and millet samples will be submitted to the USGS laboratories for chemical analysis.

***Contact Mary Sue Liss (see page 8) to get on the mailing list or have the mailing list corrected***

***If you have questions about the Expanded Monitoring Program, please contact Tracy Yager (see page 8). Commonly asked questions will be included in each Quarterly Report.***



## Definitions

*Alluvial aquifer*—Unconsolidated (uncemented) sediments and gravels in current or historic stream channels or floodplains that contain significant amounts of ground water.

*Bedrock aquifer*—Water contained in the fractures or pore spaces of rock formations that is of sufficient quantity to yield water to wells. In many cases, bedrock aquifers underlie soil or other uncemented materials.

*Biosolids*—Solid organic matter recovered from a sewage-treatment process that meets regulatory criteria for beneficial use, such as for fertilizer. Metro District applies Grade I, Class B biosolids at Deer Trail. Regulations require that land-applied biosolids must meet or exceed Grade II, Class B. Grade I exceeds Grade II.

*Radionuclides*—A radioactive atom characterized by a given number of neutrons and protons in its nucleus. For example, plutonium concentrations include plutonium-238 or plutonium-239, which are specific isotopes.

*Runoff*—The rain that hits the ground and flows over the land surface into drainages instead of infiltrating into the soil. Runoff can wash particles of soil, rock, plants, and biosolids from the land surface into the drainages.

*Stakeholder*—Any person or group (including the Metro District) interested in or concerned about the Expanded Monitoring Program.

*Thermistor*—A device used to measure temperature through a semiconductor that changes electrical resistance quickly and predictably with temperature.

## Contacts

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State Biosolids Coordinator: Lori Tucker, 303-692-3613

U.S. Environmental Protection Agency: Bob Brobst, 303-312-6129

*2nd annual stakeholder  
meeting  
was held September 21, 2000, in  
Agate, Colorado. Call Tracy  
Yager or Mary Sue Liss for more  
information.*

*Prepared by Tracy Yager and Dave  
Smith, November 2000, in cooperation  
with Metro Wastewater Reclamation  
District*

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